REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	15 December 2000	MONOGRAPH

4. TITLE AND SUBTITLE

ARMING THE SKIES: THE RIGHT TIME HAS NOT ARRIVED

5. FUNDING NUMBERS

6. AUTHOR(S)

MAJ KIRK D. TAYLOR

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

School of Advanced Military Studies
Command and General Staff College
Fort Leavenworth, Kansas 66027

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

US Army Command and General Staff College
Fort Leavenworth, Kansas 66027

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for Public Release: Distribution is Unlimited

12b. DISTRIBUTION CODE

A

13. ABSTRACT (Maximum 200 words)

see attached

14. SUBJECT TERMS

15. NUMBER OF PAGES
46

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

Arming The Skies: The Right Time Has Not Arrived

A Monograph
by
Major Kirk D. Taylor
United States Army

School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas

Second Term AY 99-00

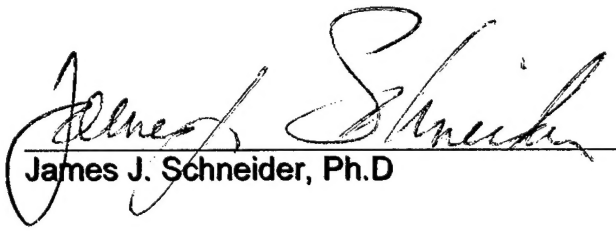
SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

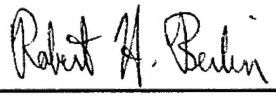
Major Kirk D. Taylor

Title of Monograph: Arming the Skies: The Right Time Has Not Arrived

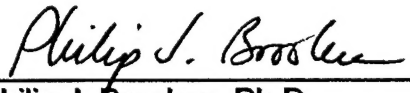
Approved by:



James J. Schneider, Ph.D — Monograph Director



Robert H. Berlin, Ph.D. — Professor and Director Academic Affairs, School of Advanced Military Studies



Philip J. Brookes, Ph.D. — Director, Graduate Degree Program

Accepted this 15th Day of December 2000

ABSTRACT

Arming The Skies: The Right Time Has Not Arrived
by MAJ Kirk D. Taylor, USA, 46 pages.

The crux of the debate as to whether the United States (US) should immediately field space weapons is not whether another nation will eventually field like weapons of its own. Rather, the primary issue is whether an immediate space weaponization program best serves national security interests. The economic significance of the civilian space sector further complicates the issue. In the year 2000, economic activity in space is anticipated to exceed $150 billion. The majority of the profits that will accrue from space activities will benefit the US. Additionally, the implications of weaponizing space far exceed immediate space control issues. The United Nations and both the Russian and Chinese governments have tried to link existing space law to proposed space weapon capabilities not inclusive in any treaty to which the US is a signatory. The anti-satellite weapons inherent in the proposed Nation Missile Defense program pose a threat to missile launch early warning assets and subsequently to nuclear deterrence. An adequate evaluation of the utility of fielding space weapons must take into consideration several factors beyond technological feasibility and military applications.

This monograph examines the benefits and drawbacks of an aggressive US space weaponization program. The US possesses a lead in space capabilities that places it in a position to field space weapons first and guarantee the security of national space assets for the foreseeable future. Additionally, the dependence of US military forces on space enablers poses a vulnerability that an adversary will likely attempt to exploit in any future conflict. Advocates of weaponizing space view the failure to weaponize space first would represent an abdication of responsibility by US government officials. The risks associated with weaponizing space include the possibility of an increase in nuclear tensions and a diminishment of US national power in terms of diplomatic, information and economic influence.

A prudent US government policy must assume that the likelihood of space remaining weapons free in the future is marginal. The US holds a substantial lead over any other space faring nation, and the probability is low that an adversary could field space weapons clandestinely. This monograph concludes that the US should continue to develop the technologies and infrastructure necessary to quickly implement a space weapons fielding program, but that the need to pursue an immediate effort has not arrived.

TABLE OF CONTENTS

The Inevitability of Space War

Space is destined for weaponization. Like the terrestrial environmental that was militarized when mankind endeavored to exploit its resources for profit, space too appears destined to emerge as a theater of war. The history of the militarization of the terrestrial domain is the history of civilization itself. As societies advanced, so too did their resources and the nature of the armies required to guard their security.[1] By 1100 BC, the Phoenicians were the dominant maritime traders in the ancient world. Their navies sailed the Mediterranean to protect that commerce. The same relationship of navies to commerce existed for the Athenians seven centuries later.[2] The US Navy continues that tradition in operations to ensure freedom of navigation to support both peacetime commercial activities and wartime lines of communications.

In 1996, space technology industries earned an annual profit in excess of 75 billion dollars. Those profits are expected to double in the year 2000.[3] In congressional testimony on March 8, 2000, General Ralph E. Eberhart, Commander in Chief United States Space Command, linked the relationship between economic activity and the military imperative to protect those economic interests.

> By 2010, cumulative American investment in space alone will reach $500-$600 billion or about as much as the value of present American investments in Europe. Both our military readiness and economic vitality are inextricably linked to the health of our military space systems. The

> dependence of our national security on orbiting satellites makes space systems a tempting target for terrorism and adversarial military operations. We will continue our emphasis on this emerging technology.[4]

Space is an arena of enormous economic and military activity. The view of space as a vast void for scientific exploration and contemplation on the origins of the universe no longer seems appropriate. Therefore, it is necessary to investigate whether space is vulnerable to the same combative trends that led to the weaponization of the terrestrial domain.

Before evaluating the utility of an immediate fielding of space weapons, delineation between space militarization and weaponization is necessary. The militarization of space entails the use of space to further military operations in the terrestrial domain. A RAND Corporation study, commissioned by the Army Air Forces in 1946, details many of the capabilities that represent space militarization. The report listed potential military missions for satellites as: missile guidance, weapons delivery, communications, weather reconnaissance, attack assessment and intelligence operations.[5] When executed, these missions clearly represent a militarization of space. However, the weapons delivery mission constitutes a form of weaponization. The United States (US) has aggressively pursued military space systems capable of executing the missions identified by the Rand Corporation.[6]

Coalition operations in Desert Storm, Haiti, Bosnia and Kosovo benefited from space enablers of terrestrial operations. The use of Global Positioning Satellite (GPS) signals facilitated navigation on the land, sea, and air. In addition, GPS signals are an integral enabler of precision-guided munitions. Satellites also provided over-head reconnaissance information, long-haul communication and weather forecast support. General Eberhardt lauded space support provided during Operation Allied Force (Kosovo).

> Support from space touched all aspects of the campaign, including missile warning, precision munitions, timely weather, around-the-clock surveillance, dedicated secure communications and accurate battlespace characterization. Victory without one combat related casualty shows just how well we have integrated air and space into true aerospace operations.[7]

Space is clearly militarized. However, space weapons were not used to target other space assets or to deliver ordinance against a terrestrial target. To date, the US has opted not to breech the space weapons employment threshold.

Advocates for the immediate weaponization of space support their position in part on the assumption that war in space is inevitable. This view of space as a future battleground is not uniquely held by the military. George Friedman, chairman of Strategic Forecasting at Tulane University and co-author of The Future of War, contends

that, "He who controls space controls the battlefield, and the manner in which wars are waged is undergoing a dramatic transformation."[8] Alvin and Heidi Toffler, co-authors of War and Anti-War, further expound on the inevitable military confrontation in space based on the historical analogy between space and the terrestrial domain.

> In the fifteenth and sixteenth centuries European powers waxed and waned in their enthusiasm for transatlantic exploration, but once the New World was discovered, there was no turning back. In the same way now, our drive into space may wax and wane, but the competing armies of too many countries are now far too dependent on missiles and satellites to imagine them ignoring the heavens. It is now becoming clear that in the future the first thing any regional power involved in conflict with the United States will do is try to scratch out its eyes in the sky.[9]

The US military has also publicly voiced the opinion that space will eventually become a "battlefield". General Joseph W. Ashy, then commander-in-chief of the US Space Command, stated in Aviation Week & Space Technology:

> It's politically sensitive, but it's going to happen. Some people don't want to hear this, and it sure isn't in vogue..But--absolutely--we're going to fight in space.[10]

General Ashy's sentiments were echoed by General Myers, his successor as Commander in Chief US Space Command, in written testimony to the Senate Armed Services Committee Strategic Forces Subcommittee on March 22, 1999.

> It is clear that no credible vision for national security and economic prosperity can ignore the opportunities or the risks associated with

> exploiting space. In past appearances before this committee, my colleagues, predecessors, and I have shared with you the belief that our way of life is inextricably linked to space. The Tofflers of the world will tell you that how a nation derives its wealth will also indicate when it will go to war. It is clear that the exploitation of orbital space is driving a new American way of making wealth. *It is also driving a new American way of employing military forces.*[11]

The recognition of space as a future theater of war is evident in the above examples. However, this recognition is not isolated to the US.

Russia and the Peoples Republic of China (PRC) are also aggressively pursuing technologies with space weapon applications. A congressional investigation chaired by US Representative Christopher Cox claims that:

> US research and development work on electromagnetic weapons technology has been illegally obtained by the PRC as a result of successful espionage. This technology combined with Russian assistance to Beijing is enabling China to develop a nuclear reactor-powered, ground-based laser that can generate enough energy to destroy satellites.[12]

Even opponents of space weaponry consider the notion of a US monopoly on space weapons as "only jingoistic wishful thinking."[13] George Friedman and other like-minded analysts dispute the validity of Representative Cox's committee findings and contend that,

> Russia, Japan and now China are just passing blips, since they lack the money and/or technology to compete with the US in the development of space-age weaponry.[14]

This contradictory view of the likelihood of a near-term space rival highlights the probable cause for a "waxing and waning" of US interest in space as described by the Tofflers. Regardless of which of the two outlooks proves correct, both concede that other potential rivals are engaged in attempts to develop a space weapons capability. The efforts of Russia and the PRC to develop space weapons demonstrate their governments' acknowledgment of space as a possible theater of war.

Applicable Space Law

Space law is problematic for several reasons. Unlike maritime law that evolved over centuries of exploration, space activity is relatively new and laws are often placed in effect prior to or just after events that the laws are intended to govern. The two most applicable examples of this type of governance are the Outer Space Treaty of 1967 and the Anti-Ballistic Missile Treaty of 1972. Both treaties were enacted at the onset of technologies designed to enable space travel and missile intercept. The problem with a preemptive approach to law enactment is determining whether the law will serve its intended purpose.

The Outer Space Treaty bans several military activities in space. Many of these activities have little relevance to current space operations. The treaty bans military exercises on the moon, nuclear weapons in orbit and mandates that nations provide assistance to astronauts in distress.[15] These mandates certainly appeared relevant to the framers of the treaty, but the applicability of the prohibitions to current space operations is questionable. If the author of the treaty intended to prohibit space weapons, the document lacks the specificity required to meet that purpose.

The Anti-Ballistic Missile Treaty of 1972 differs significantly from the Outer Space Treaty. The Anti-Ballistic Missile Treaty applies to only the US and Russia (then USSR). Its origin was a response to the emergence of anti-missile technology and the resultant impact on nuclear

deterrence. Whereas the Outer Space Treaty bans specific actions, the Anti-Ballistic Missile Treaty bans all anti-ballistic missile activities with the exception of specified capabilities. By wording the document in this manner, the treaty is easily applied to subsequent technological developments. The treaty specifically allows the US and Russia to field one fixed ground-based anti-ballistic missile system in a specified location. The furor over the Strategic Defense Initiative and National Missile Defense programs is based on non-compliance with the activities allowed in this treaty. The Anti-Ballistic Missile Treaty is reviewed jointly every five years and subject to amendment. Additionally, either country can withdraw from the treaty if it decides it is in the country's supreme interests.[16]

A common misperception concerning space weapons is that current treaty obligations prohibit the US from pursuing an aggressive space weapons fielding program. This is false with the exception of those activities prohibited in the Outer Space and Anti-Ballistic Missile Treaties.

> A fundamental truth of international law is that if an act is not specifically prohibited, then that act is permitted. It permits the deployment in earth orbit of non-nuclear, non-ABM weapon systems; and any conceivable activity not specifically prohibited.[17]

The US is not a signatory to any space law that would prohibit the deployment of a large variety of space weapons outlined in a following chapter.

A Contextual Framework for Examining Space Warfare

An adequate examination of space warfare requires an appropriate conceptual framework. Carl von Clausewitz proposed in On War that, "War is the continuation of policy by other means."[18] The implication is that the decision to wage war is a conscious choice based on the interests of the state. This explanation works well within the context of state-on-state warfare, but it also tends to limit the discussion of future war to nation-states. The limitation of von Clausewitz's maxim in relation to space war is mitigated by the nature of space operations. The prohibitive costs associated with space operations narrows the field of potential space combatants to actors with the resources found exclusively in the coffers of developed nations.[19] The pertinent implication of von Clausewitz' maxim for space warfare is that nations will weigh the decision to field and utilize space weapons based on national interests as opposed to a philosophical preference to maintain the weapons-free status of the heavens. This premise is appropriate for arriving at an objective determination of the utility of an aggressive US space weaponization program.

US President William Clinton relevant policy objectives for space are outlined in the US goals for national space activities.

- Enhance knowledge of the Earth, the solar system and the universe through human and robotic exploration;
- Strengthen and maintain the national security of the United States;
- Enhance the economic competitiveness, and scientific and technical capabilities of the United States;
- Encourage State, local and private sector investment in, and use of, space technologies; and
- Promote international cooperation to further US domestic, national security and foreign policies.[20]

The positive and negative influence of space weapons on the attainment of these space goals provides evaluation criteria for determining the utility of space weapons.

Many of the assets and activities engaged in achieving the national space goals. The Secretary of Defense and Director of Central Intelligence are tasked with oversight of national security space activities.

- Providing support for the US's inherent right of self-defense and for our defense commitments to allies and friends;
- Deterring, warning, and if necessary defending against enemy attack;
- Assuring that hostile forces cannot prevent our own use of space;
- Countering, if necessary, space systems and services used for hostile purposes;
- Enhancing operations of US and allied forces;
- Ensuring our ability to conduct military and intelligence space related activities;
- Satisfying military and intelligence requirements during peace and crisis as well as through all levels of conflict; and
- Supporting the activities of national policy makers, the intelligence community, the National Command Authorities (NCA), combatant

> commanders and the military Services, other federal officials, and continuity of government operations.[21]

These mandates delineate how military space activities support the larger national space goals. The quandary is that an optimization of national security space capabilities could negatively impact non-military related space goals. This is the crux of any debate concerning space weaponization. The policy issue that arises, and the basis for the recommendations made by the author, focuses on the inherent trade-off between enhanced national space security versus a possible dampening of civil and commercial space benefits.

Pillars of US Space Operations

Space operations rely upon three pillars to successfully execute its missions. These components are the ground stations, launch facilities, and satellites in operational orbit. While each pillar shares a common purpose of supporting the exploitation of space, they also represent separate and distinct opportunities for an enemy to deny the US space dominance.

A common impression of space operations is that a satellite, once launched, operates nearly autonomously. This impression is false. Satellites require near continuous monitoring and flight profile adjustments to ensure the continued services for which they were launched.[22] The control facilities that execute these missions are terrestrial-based and vulnerable to interdiction by potential adversaries. A critical element of the control facilities' vulnerability is that most are fixed-sites with modest redundancy. Simultaneous attacks by small forces on three or more sites could severely degrade the ability of US military forces to access space capabilities.[23] This method of attack would not require an adversary to possess space capabilities of its own.

Another misconception of US space capability concerns the nation's launch capacity. The US government currently operates only two launch facilities. The east coast launch facility is located at Cape Canaveral, Florida. A similar, but less capable facility is located on the west coast at

Vandenburg Air Force Base, California. The rationale for the location of each site is based on the added degree of safety gained by launching a rocket over sea for the boost phase of its flight. By limiting itself to two launch sites, the US has accepted the risk of possessing only one site capable of executing launches to support geosynchronous and non-geosynchronous orbits.[24] The lack of redundancy in launch facilities reduces the number of targets a potential adversary must interdict to deny the US the ability to replace non-operational satellites. Launch facilities, like control facilities, are vulnerable to attack by non-space faring adversaries because they too are fixed and terrestrial-based.

The third pillar, the satellite once in orbit, differs significantly from the two previous pillars due to its freedom from direct terrestrial attack. The cost to launch satellites is exorbitantly high. These costs are linked to the weight of the satellite and the subsequent propulsion required to place the satellite in orbit. Defensive measures to protect satellites from kinetic and directed energy weapons add substantially to the weight of a satellite. Consequently, the current constellations of commercial and military satellites possess little or no defensive shielding.[25] The resultant vulnerability of satellites to all but environmental hazards imbues satellites with a fragility that has no terrestrial comparison. This susceptibility to damage is further exacerbated by the nature of satellite orbits. Satellites travel along predictable paths. This enables

an adversary to target a satellite with a high degree of certainty. Any nation with inter-continental missile launch capability can easily adapt this technology to intercept a satellite of its choosing.[26] The number of potential adversaries with this capability is relatively small, but the ongoing proliferation of ballistic missile technology will continue to increase that number.[27]

The Realm of the Possible

The pace of technological change in the space sector makes the task of determining the realm of the possible in space weaponry difficult. An analyst who endeavors to predict military implications of the next major technological break-through in metallurgy, rocket propulsion or nano-computerization is speculating at best. This chapter avoids this pitfall by limiting its examination of space weapons to technologies considered immediately possible or achievable in the near future. None of the weapon systems discussed are banned by current treaty obligation. Finally, the military implications of each weapon system are presented to illustrate its possible uses.

Since the 1980's, both the US and Russia have possessed the capability to field kinetic-energy anti-satellite weapon systems.[28] The technology necessary to field this type of weapon originated in 1944 when the Germans were the first to reach outer space with the A-4 rocket.[29] The continued development of missile and rocket technology during the Cold War resulted in a capability to deliver payloads into outer space with amazing accuracy. The Russian kinetic-energy anti-satellite weapon is a ground-launched missile the uses a proximity fuse to "shower" a satellite with shrapnel. In the 1980's, the US developed a similar weapon that was launched from the wing of a F-15 jet fighter.[30] A recent US Army effort to develop a weapon similar to the Russian anti-satellite system was killed when President Clinton line-item

vetoed the program in the 1998 Congressional budget proposal.[31] If either nation decided it required these weapons, the fielding of kinetic-energy anti-satellite weapons could progress with adequate resources.

The intercept of satellites with missiles would appear difficult given the high speeds (8,000 mps in low earth orbit)[32] with which satellites travel. If this were true, a nation would gain little military utility by fielding a terrestrially-fired anti-satellite missile system. However, satellites are relatively easy targets to engage for several reasons. Satellites travel a very predictable path that simplifies the problem of radar acquisition and identification. Secondly, satellites are not agile in the sense that an aircraft is maneuverable. Small corrections to satellite flight profiles are used to ensure that they remain in a usable orbit, but the paucity of fuel to conduct such maneuvers hinders its survivability if under deliberate attack.

This method of anti-satellite warfare is inefficient. The first problem with using a terrestrial-based missile system is the missile is used once and then lost. Second, the use of a kinetic kill mechanism creates space debris. The possible repercussions of destroying/disabling other satellites in the immediate vicinity or that will pass through a near orbital plane are high. Last, the effects of kinetic-energy weapons are non-reversible. This weapon system does not allow for a lesser response to a threat

satellite. The increased use of commercially-owned space assets by military organizations has the potential to create problems beyond the scope of the combatants. It is easy to envision that a more appropriate response to a threat posed by a satellite owned by an international conglomerate would entail a temporary non-lethal disablement of the satellite. Kinetic-energy weapons do not allow for that type of response.

Directed-energy weapon systems are also technologically feasible. Laser technology was pioneered by the Soviets in the early 1950's. Since then the technology has matured to the point at which it has military utility. Today, the US Air Force is preceding with the development of the Airborne Laser (ABL) program, which is designed to acquire, track, and destroy theater ballistic missiles.[33] In addition, the US Army has tested the Mid-Infrared Advanced Chemical Laser (MIRACL) against an obsolete air force satellite.[34] While a great deal of energy is required to destroy an object using directed-energy, the same is not true for disabling optics. The US is capable of fielding mobile laser platforms to a theater of operation with only incremental improvements.

Directed-energy weapons also offer a far greater range of options to decision makers than do kinetic-energy weapons. Directed-energy weapons provide decision makers with the choice of either lethal or non-lethal responses to threat satellites. This is particularly significant due to the trend towards military use of commercial satellite

assets. Directed energy anti-satellite weapons do not create the space debris that is inherent in a kinetic-energy weapon attack. Thus, an attack with a directed energy weapon avoids creating unintended hazards to other satellites in near orbits.

The above sets of space weapons are limited. These weapons serve only one purpose (anti-satellite), and each weapon must overcome barriers created by the earth's atmosphere in order to have an effect in space. The kinetic-energy weapons must achieve adequate thrust to defeat the effects of gravity. The large amounts of fuel required to create the propulsion necessary to reach space lowers the destructive payload the missile is capable of delivering to the target. The directed-energy system suffers from signal propagation as it transitions the earth's atmosphere. Thus, the power required to fuel the laser is exponentially higher for a ground-based system as opposed to a similar space-based laser system. A logical solution to the problems inherent in both ground-based systems is to relocate those assets in space.

Space-based weapon platforms would offer a far more effective and responsive method of engaging targets in both the space and terrestrial domains.[35] The effects of gravity would not degrade the performance of a space-based kinetic-energy intercept vehicle. The accuracy of the weapon would also increase due to the proximity of the launch platform to the target. Likewise, the performance of a space-based

laser system would also increase. The lack of propagation of the energy wave would reduce the power required to generate the same destructive force at the target. In addition, targeting accuracy would also improve due to the increased proximity.

Space-based weapons intended to attack terrestrial targets are technologically feasible. The degree of accuracy in which a nation can place a satellite in orbit is directly related to the expertise required to de-orbit an object with accuracy. The responsiveness and kinetic destructive power of space-based "artillery" is evident. Targets located anywhere on the earth's surface are reachable within minutes of a space-based weapon system. In fact, a space-based "artillery" system would use gravity to generate greater range and destructive force. The operational and strategic responsiveness of such weapons is clear. The US military would no longer need to relocate cruise missile launch platforms to engage a short-dwell time target. The time lag from detection to engagement of targets by space platforms is conceivably far shorter than currently feasible with ground-based capabilities. The fears that Sputnik spawned in the US of de-orbited weapons are no longer unfounded.

Destabilizing Effects of Space Weaponization

Space weapons have a destabilizing effect on world politics. The proposal to erect a US national missile defense system has created apprehension both in the US and abroad. Senator Frank Lautenberg, a New Jersey Democrat, states,

> It confirms my fears that we are rushing into a decision on national missile defense without knowing the diplomatic implications. A national missile defense program is strongly opposed by Russia and China.[36]

Speaking at the United Nations on April 25, 2000, Russian Foreign Minister Igor Ivanov clearly confirmed Senator Lautenberg's impression of Russia's stance on the issue,

> Russia is prepared to make deep cuts in its nuclear warheads, but not if the United States plans to construct a missile defense system that would destroy the 1972 pact, the Anti-Ballistic Missile Treaty. The prevailing system of arms control agreements is a complex and quite fragile structure. Once one of its key elements has been weakened, the entire system is destabilized.[37]

Senator Lautenberg and Minister Ivanov responses are to a purely defensive weapons program. In theory, a national missile defense system could embolden a nation to consider the feasibility of winning a nuclear war, but the national missile defense program under consideration would defend against a limited number of missiles. The limited defense would not provide one hundred percent protection of the US against a massive retaliation by Russia. The Russian

rhetoric is no less heated despite this fact. It is appropriate to suspect that an offensive space weapons program would generate an equal or greater amount of opposition.

The Threat of a New "Arms" Race

Arms races are not a phenomenon of the twentieth century. It is easy to draw parallels from history that demonstrate the propensity of arms races to result in armed combat. The Athenians and Spartans engaged in a naval build-up that ultimately contributed to the outbreak of the Peloponnesian War. The arms races in Europe that preceded the Napoleonic and World Wars I and II also give credence to an intuitive link between competitive arms build-up and eventual combat. The most obvious exception to a link between arms races and armed conflict is the Cold War. Both the NATO and Soviet Bloc nations bolstered armaments to an unprecedented level, but they never engaged in a third world war. The nuclear arsenal at the disposal of both sides explains in part the reluctance of both sides to engage initiate a large-scale conventional war. The perception of national vulnerability to nuclear attack outweighed the fear of the rival's conventional first-strike capability. The answer to the question of whether the use of space weapons entails the same danger of crossing a nuclear threshold is of significant concern.[38]

The most likely participant in a space weapons race is the US. According to General Myers, "Today, the United States is the world's space superpower, the leader in this once exclusive club."[39] As the world leader in space faring activities, the US has led an effort to keep space weapons-free. The US government's reluctance to field such weapons

is a function of the benefits it reaps in maintaining the status quo. The US could field and employ space weapons with a relative ease in comparison to its potential rivals. However, US commercial space industries enjoy greater prosperity as a result of the freedom from operating in a hostile environment. Additionally, US Space Command is tasked with protecting both military and military-use commercial satellites, and the burden of executing that mission exponentially increases if space is weaponized. These factors combine to illustrate the rationale to preserve space as a weapons-free arena.

The large gap in space capabilities between the US and any potential rival has grown so wide that a long-term space weapons race versus the US is most likely fated for failure. This helps to explain the reluctance of other nations to weaponize space, but this outlook fails to acknowledge the possible short-term benefits that an adversary could reap if it was able to field space weapons clandestinely. A surprise attack on US space assets, coupled with terrestrial military operations, could cripple a US response to a military crisis. If it were not for such a threat, no logical case for a US fielding of space weapons is possible.

A nation must possess several competencies to wield space power. The following list defines those required attributes.

Facilities: A nation must possess the hardware necessary to conduct space operations:

manufacturing facilities, launch facilities, and command and control facilities. However, ownership of these capabilities is not as essential as guaranteed access to the services required.[40]

Technology: Laboratories must develop basic and applied research programs relevant to the full spectrum of capabilities related to space operations. National and private laboratories should ideally work in cooperation with universities that encourage students to enter the field.[41]

Industry: Private industry must vigorously pursue space technology and applications for "business and profit" and fund their own in-house basic and applied research to maintain a competitive edge in the designing, manufacturing, deploying, and operating of space systems.[42]

Hardware and Other Products: The actual space vehicles (e.g., the payloads and the boosters) and the material required to operate them. The level of spare parts and of reserves (providing a rapid replacement of losses, or a "surge" to deploy more-numerous-than-normal assets) is an often-overlooked element of "space power".[43]

Economy: A strong economy generates the resources necessary to fund a strong space program, both governmental and commercial programs. Space activities often require substantial new investments. In temporary hard times, wise users strive to protect space-related investment due to the long-term payoff as indicated by the ever-increasing economic activity in space.[44]

Populace: The citizenry must be well educated with sufficient numbers of engineering specialists and theoretical scientists. Just as importantly, the populace must be comprised, in part, of an influential group of technology proponents.[45]

Education: There must be access to a sufficient number of universities (either domestic or foreign) offering relevant engineering and science courses from undergraduate through doctorate-level, in order to generate the knowledge and talent pool required to support and grow a vibrant

> and vigorous space industry. In addition, domestic universities, in cooperation with the government and other institutions, must conduct research programs to keep the nation on the leading edge of space-related technology.[46]
>
> **Tradition and Intellectual Climate:** A nation's space activities require a broad popular appreciation and support in order to have the endurance to tolerate both long-term economic and political variations as well as short-term setbacks. Public enthusiasm for space activities translates directly into a pool of candidate professional space workers and constant source of ideas and inspiration.[47]
>
> **Geography:** The free exercise of space operations requires a launch site with ample downrange safety zones and usual a far-flung string of communications sites. This favors geographically large nations or those with good diplomatic relations with potential host nations.[48]
>
> **Exclusivity of Capabilities/Knowledge:** The most volatile aspect of power in general is related to features which one owner alone possesses, or one owner alone understands the capabilities of. Since experience demonstrates that any such benefits are bound to be short-lived, efforts to protect these features must be matched by efforts to develop replacement features.[49]

The above list provides a framework from which to examine the likelihood that a nation or block of nations possess the capability to engage in a space weapons race. As the world leader in space operations, the US is abundantly endowed in each category with the exception of launch facilities. This gives further credence to the assumption that the US is the most likely nation to participate in any space weapons race, but an arms race is never one-sided.

The remnants of the former Soviet space program, now resident in the Russian state, is the closest rival to US space dominance. While the scope of Russian space activities continue to dwindle and its infrastructure degrades from lack of funds, it is the only space program that has the experience and technological expertise to engage in the full-spectrum of space activities.

A critical assessment of the Russian space program could easily point to the decaying status of Russia's legacy space systems as an indication of a non-space rival. That would neglect to consider both former President Boris Yeltsin's rhetoric and the technological investments of previous regimes. In a letter to President William Clinton, Yeltsin wrote, "At one time we possessed an anti-satellite capability. We renounced it as soon as we realized the futility of a first-strike notion."[50] In addition, Russia still possesses a far larger satellite launch capability than the US.[51] The waning state of the Russian space program belies the potential it possesses. With a large influx of monetary resources, Russia is capable of providing a strong challenge to US space dominance.

China is yet another likely competitor in a space arms race. China has turned to a policy of espionage and cooperative agreements with nations such as Russia to jump-start its space program. The Chinese government has clearly opted to focus on space operations to solidify its status as a global power.[52] The Chinese already possess modern

intercontinental ballistic missile technology; this capability translates well into many space competencies.[53] Additionally, the Chinese government has succeeded in importing both high-performance computers and software known as 'finite element' software. These information technologies are essential to the development and fielding of weapons applications ranging from stealth to space-based laser systems.[54] The conclusion that China is not only a likely candidate to field space weapons, but that it is in fact currently endeavoring to field such weapons as a matter of government policy was reached by a Congressional panel chaired by Republican California Representative Christopher Cox.

> The People's Republic of China (PRC) is believed to be developing space-based and ground-based anti-satellite laser weapons. As a result of their successful espionage efforts, the PRC can now employ weapons to attack satellites and missiles. Furthermore, China is viewed as intent on deploying such a system. That assessment echoes what US intelligence officials have said in earlier analyses of Chinese military plans.[55]

This view appears alarmist. China has energized its space program through the use of increased funding and clandestine activities, but it is still well behind the US in both technological capabilities and economic support.[56] The US Department of Defense (DoD) holds a similar opinion. In a November 3, 1998 news brief, US Navy Captain Mike Doubleday reaffirmed the DoD position that the Chinese military does not currently possess an operational anti-satellite

capability.[57] However, it is foolhardy to assume that such a gap entirely mitigates the threat.

China is remote in terms of its proximity to the US. A military crisis involving the US and China would inherently place a great premium on US space capabilities for a wide gamut of military support activities.[58] If China conducted simultaneous military actions and space denial operations to assert sovereignty over the Spratley Islands or Taiwan, the US military response would likely flounder without ready access to space enablers.[59] This scenario is relevant given both the Chinese claim to sovereignty to the disputed areas and the US bi-lateral agreement to render military assistance to Taiwan in case of Chinese aggression.[60]

Unlike Russia and China that share a historical animosity with the US, Europe is also potential rival to US space dominance. Especially since the advent of the European Union (EU) and European Space Agency (ESA), the EU is best postured to compete with the US in a space weapons race. The EU's Gross Domestic Product roughly equals that of the US.[61] In addition, the EU is endowed with a larger but equally well-educated population and an enormously powerful technological-industrial base.[62] The fourteen nations of the ESA combine annually to spend roughly four times as much as Russia and China combined on space activities.[63] A trend towards even more combined space efforts across the spectrum of scientific, commercial and military activities is expected.[64] From an economic,

technological, facilities and educational perspective, the EU possesses the capability to match the US in space.

The likelihood of a challenge to US space dominance suffers from disparate national goals and interests. Additionally, the EU has shared cultural, political and economic interests with the US. It is imprudent to assume that the current status of geo-political relations will remain unchanged for the indefinite future. While not a current threat to US space dominance, the EU and ESA are better postured to compete in space than any other potential rival. As the EU evolves and develops a more unified stance towards both international trade and regional hegemony, the potential for a volatile conflict of interest with the US will increase. In which case, the space threat posed by the EU could transition from benign to dangerous in a short period of time.

Japan, like the EU, is considered an ally by the US government. However, much like China, Japan has historically pursued a regional hegemonic role in East Asia. Any discussion of Japan as a potential space rival is often debunked by a reference to its close political relations with the US. Regardless, Japan is engaging in a robust effort to improve space capabilities. Its annual space budget (US$2 billion) equals or exceeds any nation other than the US. Japan has also benefited from its deep cooperation with the US space shuttle and Spacelab programs.[65] Japan is also a major partner in the

International Space Station, and is developing a special add-on research module. Despite these efforts, John Logsdon, Director of the Space Policy Institute at George Washington University in Washington, DC, asserts that, "Japan's strategy is widely seen as a failure."[66] Similar to the EU, the current geo-political realities make it unlikely that Japan would employ military means to establish itself as the preeminent power in its region. This mitigates the risk that Japan poses to US space dominance.

The previous analysis of potential space rivals did not include non-state actors. The primary reason for which is the exorbitant cost associated with space activities. This does not imply that less-technologically advanced nations and other entities cannot engage in some forms of space warfare. Terrestrial attacks on command and control facilities, launch facilities and space-supporting computer networks are not beyond the capabilities of an adversary intent on denying US forces access to space enablers. These acts of terrorism, despite their power to disrupt US military efforts, are outside a discussion of a space arms race.

Effects of a Space Weapons Race with One Competitor

An advocate for an immediate US space weaponization program might advance the position that the large gap in space capabilities between the US and the rest of world offers the perfect opportunity to ensure US space dominance. This type of strategy would almost certainly expand the current US advantage in space, but it would also fail to consider second and third order effects of such a course of action. If the US pursues fielding space weapons and no rival emerges to challenge US space dominance, it will have a destabilizing effect on world politics. Rival nations could use other means to counteract the US space weapon efforts.

An appropriate context for examining the possible tools a rival nation might employ in response to US space dominance is diplomatic, information, military and economic activities (DIME). Space activities support each element of the DIME. Status as a space faring nation confers a degree of technological competence on a nation. As such, a nation accrues diplomatic legitimacy as a modern nation. Evidence of this phenomenon is China's space efforts. The linkage between space activities and information as a tool of national power is obvious. The range of capabilities that satellites provide in terms of communications and reconnaissance are quickly outstripping any similar terrestrial-based assets.[67] The space enablers that facilitated coalition success in Operations Desert

Shield/Storm illustrate the military significance of space activities. Additionally, the possible weaponization of space would further intermingle space with the military arm of national power. The economic aspects of space are also clearly evident. The doubling of economic activity in space in the past four years indicates that space will continue to play an ever-increasing role in the use of economic power to influence world events. Given a scenario in which the US is the lone power capable of denying other nations the benefits of space activities, to what extreme might a rival act to retain its sovereign right to space?

The threat of nuclear conflict dominated diplomacy during the Cold War. With the end of the Cold War, the threat of a deliberate nuclear exchange between the Soviets and the US diminished substantially. With the possible exception of concerns about adequate command and control of the former Soviet nuclear arsenal, the world community was relatively free from agonizing over the possibility of a nuclear holocaust. Opponents of space weapons point to the risk of unhinging the current thaw in nuclear tensions. Excerpts of a letter from Former Russian President Boris Yeltsin to US President William Clinton further highlight this argument,

> The obvious aim of the US anti-satellite weapons program is to deny space surveillance and control systems of other countries, including of course, the Russian ones. Within our military doctrine there is no place for such systems, which constitute an absolutely destabilizing factor.

> Anti-satellite weapons jeopardize stability by putting warning systems at risk, preventing one side from knowing when it is under attack.[68]

The above excerpt lacks the typical bombastic flair of Russian diplomacy, but it does highlight the concern that the greatest nuclear threat to the US has over space weapons. Nuclear deterrence has worked due to the unlimited consequences of retaliation to a first-strike.[69] A US monopoly on space weapons could shatter the context within which nuclear deterrence has prevailed. To dismiss the possibility of a Russian nuclear response to a US space weapons monopoly would ignore Russia's stated policy on like issues. The Russian government's official policy for response to a hostile information attack is nuclear retaliation.

The relationship between space operations and the information element of national power heightens the possibility that space weapons could have nuclear consequences. Whether a US monopoly in space weapons would cross the Russian threshold of an imminent information attack and thus warrant a nuclear response is unclear. However, that the possibility of such a reaction to other conflicts of interest between the two nations has influenced US actions since the onset of the nuclear arms race. This supports a compelling argument that the marginal degree of security provided by space weapons is not worth risking the unlimited consequences of a nuclear exchange with Russia.

An escalation in nuclear tensions is not the only possible consequence of a US space weaponization program. The US enjoys a substantive advantage in space activities and any overt attempt to limit the access of other nations to the benefits of space is likely to meet with opposition in other forms. The US could lose the favorable perception it enjoys as a relatively benign world leader and result in an anti-US alliance. The isolationism that would ensue could bring with it all the mistakes of US foreign policy practiced in the inter-war period.[70] The informational aspect of US national power would suffer due to the loss of the cultural influence the US has gained by pursuing a more idealistic set of policies.[71]

The positive military effects of increasing the US lead in space with offensive capabilities are substantial. Anti-satellite weapons could deny adversaries access to space enablers in combat. Offensive space-to-ground weapons would provide unparalleled responsiveness. The ability to assure access to secure satellite communications and reconnaissance while denying the enemy the same would provide US commanders with an overwhelming advantage in battlefield awareness. Space dominance of this magnitude would almost guarantee success on the battlefield.

Conclusion

The risks that a weaponized space poses to US interests are clear. It is equally clear that a nation will eventually combine the technological wherewithal with the perceived need to field space weapons to defend its vital national interests. The larger question is whether the US has reached such an epoch? The current status of the US military's ability (or lack there of) to exercise space control poses a military risk due its reliance upon space enablers and its military's expeditionary strategy. However, US policy makers must weigh the risk of a yet unrealized threat against an even more unclear set of disadvantages.

The technological leap from the first armed aircraft to nuclear weapons took less than half a century. Since the launch of Sputnik on October 4, 1957, space has remained peaceful for nearly the same length of time. For an advocate of space weapon, the past forty-three years are an anomaly. The ever-increasing economic and military stakes at risk in space suggests the need exist to enter into an era of space weaponization. As regrettable as the scenario appears, the alternative of accepting the risk that another nation will weaponize space before the US is even more dismal.

An opponent of space weapons might look back to the same forty-three years with a view that it is a new norm as opposed to an anomaly. With an almost mystic rationale,

they claim that regardless of the ills humans have wrecked on the earth in the past, the human race was never meant to arm the heavens.[72] Perhaps this is a residual effect of the first space race between the US and Soviet Union. Despite the military implications, the space race was as much a matter of national pride and prestige. A competition with military overtones, but it was also conducted in a peaceful manner.

An intuitively pleasing as idealistic values are as national policy, they have rarely served the nation well in world affairs. A dispassionate assessment of the space weaponization issue must at the least concede that prudence requires the US government to assume that at some time a nation will opt to weaponize space. It is also necessary to assume that no nation has the capability to race past the US in space capabilities clandestinely. This is not meant to dismiss the possibility that another nation could field space weapons without the US government's knowledge. Rather it assumes that no nation could build an armada of space capabilities that could negate US space activities without an opportunity to match those same efforts.

To whether the US should engage in an effort to weaponize space, a review of the benefits and risks of proceeding with space weaponization in the current political and technological context is necessary. The US currently enjoys an overwhelming lead over any potential rival in space. Nations historical antagonistic towards the US are

pursuing capabilities with space weapons applications; those same efforts are rudimentary in comparison to like US efforts. However, if China were successful in clandestinely fielding effective anti-satellite capabilities, a US military response to the East Asian region would suffer with a possible cost in lives now commonly deemed as unacceptable. While such consequences are dire for those immediately embroiled in the battle, the effects on a strategic scale are temporary in nature.

The detrimental effects to the US government's use of information as a tool of national power are not nearly as transitory. US policy goals of engagement and enlargement are heavily dependent upon the goodwill of sister nation and the perception of the US as a generous benefactor. A move to weaponize space preemptively risks an evaporation of that perception. US diplomats would find it difficult to explain the US requirement to field destabilizing weapons capabilities without a realized threat. It is probable that other nations would form an anti-US coalition in response to US space weapons. Nations with little in common often cooperate in endeavors in which their interests merge.

It is not coincidental that the US government enjoys its most favorable position of influence in the world at a time when the US economy has experienced unprecedented growth. Anti-American sentiment would threaten the US economy and its subsequent ability to wield that tool of national power. The possibility of increased barriers to

trade for US exports and boycotts of US produced commodities is also likely. A US move to weaponize space first would place the economic gains earned in the past decade at risk.

An assessment of the utility of fielding space weapons must also include the possible Russian government responses. The end of the Cold War has reduced the possibility of a nuclear war and allowed the US Congress to pare back on its discretionary military expenditures. Any action that threatens the status quo, as it pertains to relations between the US and Russia, must account for the chance of a return to Cold War diplomacy.

As is the case with most issues of vital national interests, no one course of action can escape the possibility of dire consequences. If the US chooses to weaponize space first, world opinion would likely turn against the US and damage the US economy. Additionally, relations between the US and Russian governments will probably return to a tone similar to the height of the Cold War. The likelihood that the Russian government would choose to employ nuclear weapons is remote, but it is certainly not beyond the realm of the possible. Conversely, if the US elects to forestall weaponizing space, it assumes the risk of a military failure and possible emergence of a space operations peer. If an adversary was nearer to the US in space capability, an advocate for space weaponization could make a more powerful argument for an immediate US effort despite the negative consequences. The fact,

however, is that no such rival currently exists. In addition, the ever-widening economic gap between the US and the remainder of the world makes the emergence of a US space peer unlikely in the near future. The appropriate time for the US to weaponize space has clearly not arrived. A cautionary note is appropriate; the US should continue to develop the technologies and infrastructure required to embark on space weaponization at a short notice. George Friedman succinctly outlined the rationale for such caution.

> Whoever controls space, therefore, will control the world's oceans. Whoever controls the oceans will control the patterns of global commerce. Whoever controls the patterns of global commerce will be the wealthiest power in the world. Whoever is the wealthiest power in the world will be able to control space.[73]

ENDNOTES

[1] Thomas D. Bell, "Weaponization of Space: Understanding Strategic and Technological Inevitabilities" Center for Strategy and Technology (Alabama: Maxwell Air Force Base, 1999) 5.
[2] Ibid., 5.
[3] Jim Oberg, Space Power Theory (Colorado: Government Printing Office, 1999) 15.
[4] Ralph Eberhart, "Statement Before The United States Senate Armed Services Committee Strategic Forces Subcommittee" (March 8, 2000) Available on-line at http://www.perterson.af.mil/usspace/cinc8mar00.htm, 9.
[5] Rand Corporation, "Preliminary Design for an Experimental World Circling Spaceship" (May 2, 1946) available on-line at http://nsarchive.chadwyck.com/msessayx.htm
[6] Unknown, "US Military Uses of Space, 1945-1991" Available on-line at http://nsarchive.chadwyck.com/msessayx.htm, 1.
[7] Eberhart, 3 of 12.
[8] Karl Grossman, "The Push to Nuclearize and Weaponize Space" Address to UP/UN Commission on Disarmament Education, Conflict Resolution and Peace (June 4, 1997): 1.
[9] Alvin and Heidi Toffler, War and Anti-War (New York: Warner Books Inc., 1993) 113.
[10] Ibid., 2
[11] Richard Myers, "Written Testimony Presented to the Senate Armed Services Committee Strategic Forces Subcommittee" (March 22, 1999) Available on-line at http://www.spacecom.af.mil/usspace/speech14.htm, 2-3.
[12] Robert Wall, "Panel Says Spying Aided Conventional Weaponry" Aviation Week & Space Technology (May 31, 1999), 31.
[13] Ibid., 3.
[14] Grossman, 1.
[15] Unknown, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Entered into Force: October 10, 1967. Available on-line at http://www.tufts.edu/departments/fletcher/multi/texts/BH500.txt
[16] Unknown, Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems, Entered into Force: October 3, 1972. Available on-line at http://www.tufts.edu/departments/fletcher/multi/texts/abm.

txt
[17] Unknown, "Space Policy and Law" US Army Space Reference available on-line at http://www.fas.org/spp/military/docops/army/ref_text/index.html
[18] Carl von Clausewitz, On War, (New Jersey: Princeton University Press, 1976) 87.
[19] Oberg, 114.
[20] William Clinton, "National Space Goals" Federation of American Scientists (September 1996) available on-line at http://www.fas.org/spp/military/program/sp97/nat-space-pol.html
[21] Ibid., 2.
[22] Eberhardt, 2 of 12.
[23] Michael E. Baum, "Defiling The Altar: The Weaponization of Space" Center for Strategy and Technology (Alabama: Maxwell Air Force Base, 1999) 1.
[24] Ibid., 2.
[25] Richard Myers, "Implementing Our Vision for Space Control" United States Space Foundation Address (Colorado: April 7, 1999) available on-line at http://www.spacecom.af.mil/usspace/speech15.htm
[26] Richard Myers, "Space Superiority is Fleeting" Aviation Week and Space Technology (January 1, 2000) available on-line at http://www.peterson.af.mil/usspace/avweek-gen%20myers.htm
[27] Michael Evans, "Defense Ministry Considers Arming Against Third World Missile Risk" The Times (London: October 28, 1992).
[28] Bill Gertz, "Yeltsin Letter Reveals Anti-Satellite Weapons" The Washington Times (October 7, 1997), 3.
[29] Oberg., 143.
[30] Gertz, 3.
[31] Ibid., 4.
[32] Ibid., 24.
[33] William Possel, "Lasers and Missile Defense: New Concepts for Space-Based and Ground-Based Laser Weapons" Center for Strategy and Technology (Alabama: Maxwell Air Force Base, 1998) 4.
[34] Gertz, 2.
[35] George and Meredith Friedman, The Future of War, (New York: Crown Publishers, 1996) 373.
[36] Unknown, "Cost of Missile Shield Debated" The Kansas City Star (April 26, 2000) A13.
[37] Unknown, "Russia Stiffens Opposition to Arms Treaty Changes" The New York Times (The Kansas City Times, April 26, 2000) A13
[38] Toffler, 120.
[39] Meyers, 1.

[40] Oberg, 44.
[41] Ibid., 44.
[42] Ibid., 44-45.
[43] Ibid., 45.
[44] Ibid., 45.
[45] Ibid., 46.
[46] Ibid., 46.
[47] Ibid., 46.
[48] Ibid., 47.
[49] Ibid., 47.
[50] Gertz, 1.
[51] William F. Buckley, "On Giving the Soviets an Inch" National Review (October 14, 1998) 66.
[52] Oberg, 63.
[53] Mark Stokes, "China's Strategic Modernization: Implications for the United States" Strategic Studies Institute (September 1999) available on-line at http://www.fas.org/nuke/guide/china/doctrine/chinamod.htm
[54] Wall, 31.
[55] Ibid, 31.
[56] Oberg, 64
[57] Mike Doubleday, "DoD News Brief" (Washington D.C.: November, 1998) available on-line at http://www.fas.org/news/china/1998/t11031998_t103asd_3.html
[58] Baum, 1.
[59] Li Tzu-ching, "CDC Thinks China and the United States Will Eventually Go to War" Cheng Ming, May 1997, 15-16, in FBIS-CHI-97-126.
[60] William Perry, "International Relations Challenges in the Information Age" Keynote Address to Senior Conference 98 (West Point, NY: May 1998). Personal Notes.
[61] Oberg, 60.
[62] Ibid., 60.
[63] Ibid., 60.
[64] Ibid., 60.
[65] Ibid., 63.
[66] John Logsdon, "The United States, the Only Space Superpower," Space Policy (November, 1997) 273.
[67] Eberhardt, 1.
[68] Gertz, 1.
[69] Lawrence Freedman, "The First Two Generations of Nuclear Strategists" Makers of Modern Strategy: From Machiavelli to the Nuclear Age (New Jersey: Princeton University Press, 1986) 748.
[70] Oberg, 110.
[71] Ibid., 110.
[72] Karl Grossman, "US Violates World Law to Weaponize Space" The Earth Journal (Winter/Spring, 1998-1999) available on-

line at
http://earthisland.org/eijournal/winter99/wr_winter99space.
html
[73] Friedman, 411.

BIBLIOGRAPHY

Baum, Michael E. "Defiling The Altar: The Weaponization of Space" Air Chronicles, April/June 1994. On-line; available from http://www.airpower.maxwell.af.mil./airchronicles/apj/apj94/baum.html.

Bell, Thomas D. "Weaponization of Space: Understanding Strategic and Technological Inevitabilities" Center for Strategy and Technology, January 1999. On-line; available from http://www.au.af.mil/au/awcgate/cst/occppro06.htm

Buckley, William F. JR. "On Giving The Soviets An Inch" National Review, October 14, 1988.

Clausewitz, Carl von. *On War.* New Jersey: Princeton University Press, 1984.

Clinton, William. "National Space Polic: An Executive Overview" Federation of American Scientists, September 1996. On-line; available from http://www.fas.org/spp/military/programs/sp97/nat-space-pol.html

Doubleday, Mike "DoD News Brief" (Washington D.C.: November, 1998) On-line; available from http://www.fas.org/news/china/1998/t11031998_t103asd_3.html

Eberhart, Ralph. "Statement Before The United States Senate Armed Services Committee Strategic Forces Subcommittee" (March 8, 2000) On-line; available from http://www.perterson.af.mil/usspace/cinc8mar00.htm

Evans, Michael. "Defense Ministry Considers Arming Against Third World Missile Risk" The Times (London: October 28, 1992).

Freedman, Lawrence. "The First Two Generations of Nuclear Strategists" Makers of Modern Strategy: From Machiavelli to the Nuclear Age (New Jersey: Princeton University Press, 1986)

Friedman, George and Meredith. The Future of War (New York: Crown Publishers, Inc., 1996)

Gertz, Bill. "Yeltsin Letter Reveals Anti-satellite Weapons" The Washington Times, October 7, 1997. On-line; available from http://www.freepublic.com/forum/a24837.htm.

Grossman, Karl. "The Push to Nuclearize and Weaponize Space" State University of New York, College at Old Westbury, June 1997. On-line; available from http://www.sonic.net/~west/un.htm.

Grossman, Karl. "US Violates World Law to Weaponize Space" The Earth Journal (Winter/Spring, 1998-1999) On-line; available from http://earthisland.org/eijournal/winter99/wr_winter99space.html

Logsdon, John. "The United States, the Only Space Superpower," Space Policy (November, 1997)

Myers, Richard. "Written Testimony Presented to the Senate Armed Services Committee Strategic Forces Subcommittee" (March 22, 1999) On-line; available from http://www.spacecom.af.mil/usspace/speech14.htm

Richard Myers, "Implementing Our Vision for Space Control" United States Space Foundation Address (Colorado: April 7, 1999) On-line; available from http://www.spacecom.af.mil/usspace/speech15.htm

Richard Myers, "Space Superiority is Fleeting" Aviation Week and Space Technology (January 1, 2000) On-line; available from http://www.peterson.af.mil/usspace/avweek-gen%20myers.htm

Oberg, Jim. Space Power Theory (Washington D.C.: Government Printing Office, 1999)

Perry, William. "International Relations Challenges in the Information Age" Keynote Address to Senior Conference 98 (West Point, NY: May 1998)

Possel, William H. "Lasers and Missile Defense: New Concepts for Space-based and Ground-based Laser Weapons" Center for Strategy and Technology, July 1998. On-line; available from http://www.au.af.mil/au/awcgate/cst/occppro05.htm

Rand Corporation. "Preliminary Design for an Experimental World Circling Spaceship" (May 2, 1946) On-line; available from http://nsarchive.chadwyck.com/msessayx.htm

Stokes, Mark. "China's Strategic Modernization: Implications for the United States" Strategic Studies Institute (September 1999) On-line; available from http://www.fas.org/nuke/guide/china/doctrine/chinamod.htm

Toffler, Alvin and Heidi. War and Anti-War (New York: Warner Books, Inc., 1993)

Tzu-ching, Li "CDC Thinks China and the United States Will Eventually Go to War" Cheng Ming (May, 1997)

Unknown, "US Military Uses of Space, 1945-1991" On-line; available from http://nsarchive.chadwyck.com/msessayx.htm

Unknown, "Space Policy and Law" US Army Space Reference On-line; available from http://www.fas.org/spp/military/docops/army/ref_text/index.html

Unknown, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Entered into Force: October 10, 1967. On-line; available from http://www.tufts.edu/departments/fletcher/multi/texts/BH500.txt

Unknown, Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems, Entered into Force: October 3, 1972. On-line; available from http://www.tufts.edu/departments/fletcher/multi/texts/abm.txt

Unknown, "Russia Stiffens Opposition to Arms Treaty Changes" The Kansas City Times (April 26, 2000)

Unknown, "Cost of Missile Shield Debated" The Kansas City Star (April 26, 2000)

Wall, Robert "Panel Says Spying Aided Conventional Weaponry" Aviation Week & Space Technology (May 31, 1999)